www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(11): 1751-1754

www.thepharmajournal.com
Received: 01-08-2022
Accepted: 07-09-2022

Kour Harleen
Department of Food Science and Technology, Lecturer at PSPS Government PG College for Women, Gandhi Nagar, Jammu, Jammu and Kashmir, India

Kaul Rajkumari
Retired HOD of Food Science Department at SKUAST Jammu, Jammu and Kashmir, India

Hans Monika
Assistant Professor at PSPS Government PG College for Women, Gandhi Nagar, Jammu, Jammu and Kashmir, India

Corresponding Author:
Kour Harleen
Department of Food Science and Technology, Lecturer at PSPS Government PG College for Women, Gandhi Nagar, Jammu, Jammu and Kashmir, India

Utilization of conventional methods of malting and roasting for nutritional profile augmentation

Kour Harleen, Kaul Rajkumari and Hans Monika

Abstract
The dried grains of both the cereals (wheat and barley) and legumes (soybean and chickpea) were variedly processed by germinating at 30± 2 °C for 72 hours for cereals and 24 hours for legumes. The germinated grains were washed and kilned by drying in hot air oven at a temperature of 65± 5 °C. Cereal and legumes were processed by roasting in hot air oven at 120 °C for 10 min and then cooled. Malted and roasted cereal and legume grains were milled into flour and analysed. Malting and roasting induced beneficial changes in the cereal (wheat and barley) and legume (chickpea and soybean). The protein content increased from 11.96 to 12.34 percent in wheat; from 12.34 to 12.54 percent in barley; from 17.34 to 19.53 percent in chickpea and from 40.63 to 42.28 percent in soy bean. Crude fibre, ash, carbohydrates also increased after malting and roasting. However the moisture content decreased after malting and roasting.

Keywords: Malting, roasting, protein, cereal, legume

Introduction

Cereals are an important source of food for a large part of the world's population. About 50% of the total protein consumed by humans is supplied by cereals and wheat alone contributes one third of the total cereal protein production. Wheat (*Triticum aestivum*) is a good source of calories and other nutrients but its protein is of lower nutritional quality when compared to milk, soybean and pea as its protein is deficient in essential amino acids such as lysine and threonine (Ndife *et al.*, 2011) [20].

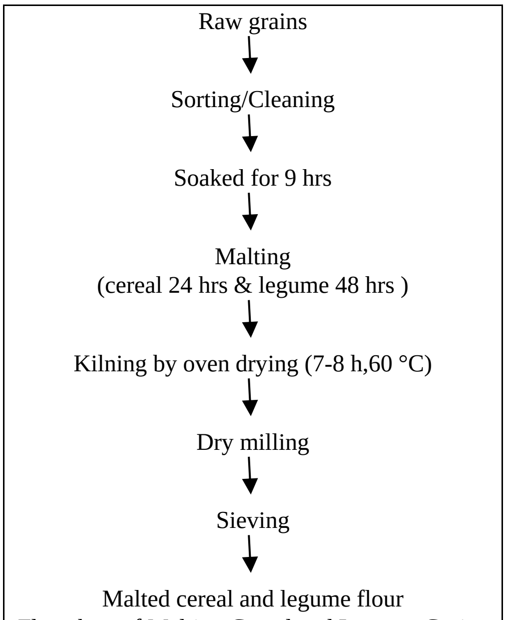
Barley (*Hordeum vulgare*) is the world's fourth most important cereal and is an excellent source of dietary fiber, vitamins and minerals. It is a rich source of tocophenols and toco-tri-enols, which are known to reduce serum low-density lipoprotein cholesterol through their antioxidant action. Because of its excellent nutritional value barley has tremendous potential to be used in high energy functional foods. In western countries, barley is used in breakfast cereals, soups, bakery flour blends and baby foods (Gupta *et al.*, 2010) [12].

Legumes have been known as ''a poor man's meat''. Soybean (*Glycine max*) is one of the most important oil and protein crops of the world. Soybean contains 30 to 45% protein. Its protein content is about two times of other pulses, four times of wheat, six times of rice grain, four times of egg, twelve times of milk and has been referred to as "the protein hope of the future" (Ndife *et al.*, 2011) [20]. Moreover, isoflavones contained in soybeans are effective cancer-preventive agents and helps in the prevention of cardiovascular diseases. Nutritionally soybean protein is an excellent complement to lysine limited cereal protein. Chickpea (*Cicer arietinum*) occupies first position among pulses representing 35% of total cultivated area of pulses and contributing 45% of total production in India. It is a rich source of carbohydrates, dietary fiber, vitamins and minerals. It contains 19.2% protein which is of best quality among the legumes. It has high protein digestibility and is rich in phosphorous, calcium and widely used in different countries as a protein source in preparation of different food products (Rababah *et al.*, 2006) [23].

The technologies suitable for developing supplementary foods include roasting, germination, milling, baking, cooking, drying, fermentation, extrusion (Carrillo *et al.*, 2007) [5]. Malting is the controlled germination followed by controlled drying of the kernels. Germination improves the nutritional quality of food products (Mansour, 1996) [18] whereas roasting improves the flavor, texture and nutritive value of grains and eliminates most of the anti-nutritional or toxic factors in legumes either partially or wholly (Mridula *et al.*, 2010) [19].

Materials and Methods

The dried grains of both the cereals (wheat and barley) and legumes (soybean and chickpea) were divided into two equal lots. One lot of each of cereal and legume was soaked in water twice their volume, for 12 hours at room temperature (28 °C). After soaking, the water was drained and the grains were evenly spreaded on white cotton cloth and were covered with same material and allowed to germinate at 30± 2 °C for 72 hours for cereals and 24 hours for legumes. During this period, the grains were kept moist by sprinkling water twice daily. The germinated grains were washed and dried in hot air oven at a temperature of 65± 5 °C till the moisture content reached to 10 percent. The dried grains were milled into flour using flour mill and the resultant flour was sieved and packed in laminated pouches and stored in an air tight container till further use (Adetuyi, 2009) [2].

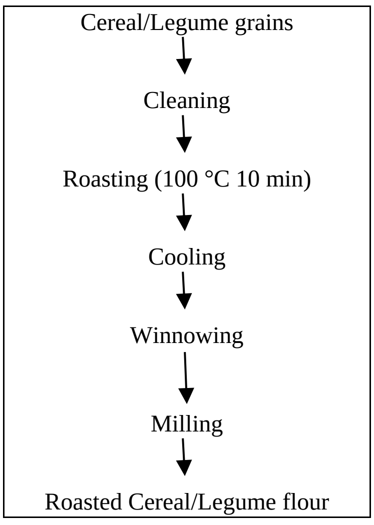


Flowchart of Malting Cereal and Legume Grains

Flowchart of Malting Cereal and Legume Grains

Flowchart of Malting Cereal and Legume Grains

As per the procedure given by Emmanuel and Okorie (2002) [9], the second lot of both the cereal and legumes were roasted in hot air oven at 120 °C for 10 min and then cooled, milled and packed in an air tight container till further use.



Flowchart for Roasting of Cereal and Legume Grains

Proximate Composition

Proximate compositions of the malted and roasted cereal and legume flours were determined according to the American Association of Cereal Chemists (AOAC) Approved Methods. Percent crude fat, crude protein, crude fibre, ash and moisture were determined by AOAC methods. The carbohydrate content was determined by difference. Minerals were determined following the procedures of Jackson (1973) [14] and Jaiswal (2003) [15] for iron and zinc and calcium respectively.

Results and Discussion

Malting generally induces important beneficial biochemical changes. The process of malting (Table 3 and 4) significantly ($p \leq 0.05$) increased the protein content in cereals and legumes from 11.96 to 12.34 percent in wheat; from 12.34 to 12.54 percent in barley. Similarly the protein content in malted chickpea increased from 17.34 to 19.53 percent and from 40.63 to 42.28 percent in soy bean. Soaking generates softening and increases water availability (Enwere, 1998) [10]. The enzymes produced during germination leads to the hydrolysis of starch and proteins with release of sugar and amino acids. Proteolytic enzymes improves amino acid availability particularly lysine, methionine and tryptophan that are lacking in cereals. This may be responsible for the progressive increase in the crude protein values recorded from the raw cereal (wheat and barley) and legume (chickpea and soybean) grains to the malted cereal and legume grains that were observed in the present study. This is probably due to breakdown of protein compounds into peptides and amino (Ade-Omowaye *et al*., 2006) [1] showing that the biochemical reactions occurring during malting also affects the protein among other molecules in the germinating grains. Kirk-Uthmar (2007) [17] also reported that during malting, protease enzymes were produced which possibly acted on the protein to produce peptides and amino acids from protein. Similar findings were reported by Khatun *et al.* (2013) [16] in germinated wheat and lentil based weaning foods, Wang and Fields (1978) [25] in corn and sorghum. Borijindakul and Phimolsiripol (2013) [4] recorded the same results while studying physicochemical and functional properties of starch and germinated flours from *Dolichos* lablab beans. Crude fibre also progressively increased after malting which was in accordance with the findings of Oluwole *et al.* (2012) [22] while developing high protein and energy density beverages from blends of maize, sorghum and soybeans for school aged children and studying the effect of malting period on selected proximate parameters and sensory qualities of developed beverages. The results are supported by the findings of Uwaegbute *et al.* (2000) [24] in chemical and sensory evaluation of germinated cowpeas (*Vigna unguiculata*) and their products. A similar trend was reported by Chinma *et al.* (2009) [6] while evaluating effect of germination on chemical, functional and pasting properties of flour from brown and yellow varieties of tiger nut (Cyperus esulentus). Findings of El-Adawy (2002) [7] also confirmed the results while studying the effects of different cooking methods and germination on nutritional composition and antinutritional factors of chickpeas. Malting increased the ash content due to increased activity of phytase which breaks protein-enzyme mineral bond to release more minerals. The result was supported by the findings of Nnam (2000) [21] in multimixes and porridges made from maize, soybean and plantain for use as complementary food. However the crude fat content decreased on malting. This might be due to the increased activities of the lipolytic enzyme during germination. They hydrolyze fats to simpler products which can be used as a source of energy for the developing embryo. Similar observation was made for bambara groundnuts (Elegbede, 1998) [8] and malted millet (Inyang and Zakari, 2008) [13]. The moisture content of malted cereal and legume flour was significantly lower than the raw. This may be resulted due to drying of malted grains to arrest the germination process. The findings are corroborated with other's Ghavidel (2006) [11] who determined the impact of germination and dehulling on nutrients, antinutrients, in vitro iron and calcium bioavailability and in vitro starch and protein digestibility of some legume seeds and Wang *et al.* (1997) while studying the effect of processing methods on nutrients and antinutritional factors in cowpea.

Table 1: Proximate Composition (%) of Barley and Wheat Flour

	Moisture	Crude Fat	Crude Protein	Crude Fibre	Ash	Carbohydrates
Barley						
Raw	8.89	1.51	11.96	1.41	1.04	74.22
Malted	8.56	1.48	12.34	1.61	1.65	74.48
Roasted	1.57	1.83	12.02	1.52	1.46	82.45
C.D. (p=0.05)	0.03	0.01	0.02	0.01	0.01	0.03
Wheat						
Raw	8.56	1.35	12.34	4.91	2.39	69.15
Malted	7.13	1.27	12.54	5.87	2.61	71.32
Roasted	1.24	1.67	12.41	5.05	2.41	77.78
C.D. (p=0.05)	0.01	0.02	0.01	0.02	0.01	0.3

The process of roasting significantly ($p \leq 0.05$) increased the crude protein and crude fat content. The increase could be attributed to the concentration of the constituents during roasting brought about by loss of moisture and reduction/destruction of certain protease inhibitors and other anti-nutrients like phytic acid and tannins which form complexes with protein and make protein unavailable during hydrolysis. The crude fibre and ash content also increased on roasting. The results are supported by the findings of Giami (1993) while studying the effect of processing on the proximate composition and functional properties of cowpea flour.

Table 2: Proximate composition (%) of chickpea and soybean flour

	Moisture	Crude Fat	Crude Protein	Crude Fibre	Ash	Carbohydrates
Chickpea						
Raw	11.03	5.64	17.34	2.55	3.45	58.18
Malted	10.55	3.34	17.53	2.89	3.95	62.08
Roasted	2.09	5.88	17.03	2.68	3.76	71.63
C.D. (p=0.05)	0.04	0.01	0.02	0.01	0.01	0.30
Soybean						
Raw	9.99	18.26	40.98	3.63	5.02	19.72
Malted	9.53	16.86	41.28	3.93	5.28	23.59
Roasted	2.03	18.73	40.63	3.78	5.13	33.34
C.D. (p=0.05)	0.04	0.02	0.02	0.01	0.02	0.40

The mineral content in wheat, barley increased significantly after malting and roasting process. Similar trend of increase in calcium, iron and zinc was seen in chickpea and soybean flour after malting and roasting. Anigo *et al.* (2010) [3] reported similar findings while studying nutritional composition of complementary food gruels formulated from malted cereals, soybeans and groundnut for use in North-western Nigeria.

Table 3: Mineral content (mg/100g) in Barley and Wheat Flour

	Calcium	Iron	Zinc
Barley			
Raw	12.02	2.34	2.50
Malted	13.03	2.89	2.72
Roasted	12.36	2.49	2.70
C.D. (p=0.05)	0.78	0.41	0.04
Wheat			
Raw	10.68	1.82	2.14
Malted	11.52	2.53	2.57
Roasted	10.92	2.24	2.34
C.D. (p=0.05)	0.12	0.06	0.04

Conclusion

The present study revealed that malting and roasting results in the enhancement of nutritional quality, as observed by the significant increase in quantity of protein and other nutrients in cereal and legume flours.The procedure requires no specialized equipment and is suitable for small-level processing. The malted and roasted cereal and legume flour can be further utilised in developing new and better food products.

References

1. Ade-Omowaye BIO, Olaniyan SA, Adeyemi IA, Ishola OO. Development and quality of non-alcoholic beverages from maize based products. Nutrition and Food Science. 2006;36(3):183-190.
2. Adetuyi FO, Badejo OF, Ikujenlola AV, Omosuli SV. Storage influence on the functional properties of malted and unmalted maize (*Zea mays* L ssp mays) and soybean (*Glycine max* L Merrill) flour blends. African Journal of Food Science. 2009;3(2):056-060.
3. Anigo KM, Ameh DA, Ibrahim S, Danbauchi SS. Nutrient composition of complementary food gruels formulated from malted cereals, soybeans and groundnut for use in North-western Nigeria. African Journal of Food Science. 2010;4(3):65-72.
4. Borijindakul L, Phimolsiripol Y. Physicochemical and functional properties of starch and germinated flours from *Dolichos lablab*. Food and Applied Bioscience Journal. 2013;1(2):69-80.
5. Carrillo NJM, Valde´z-Alarco´ NC, Gutie´Rrez- Dorado OGR, Ca´ Rdenas-Valenzuela R, Mora-escobedo JA, Garzo´ n-Tiznado, *et al*. Nutritional properties of quality protein maize and chickpea extruded based weaning food. Plant Foods for Human Nutrition. 2007;62:31-37.
6. Chinma CE, Adewuyi O, Abu JO. Effect of germination on the chemical, functional and pasting properties of flour from brown and yellow varieties of tiger nut (*Cyperus esculentus*). Food research International. 2009;42:1004-1009.
7. El-Adawy TA. Nutritional composition and antinutritional factors of chickpeas (*Cicer arietinum* L.) undergoing different cooking methods and germination. Plant Foods for Human Nutrition. 2002;57:83-97.
8. Elegbede JA. Legumes In: Osagie AU and Eka OU. Nutritional Quality of Plant Foods. Post Harvest Research Unit, Department of Biochemistry, University of Benin, Benin City, Nigeria; c1998. p. 120-133.
9. Emmanuel CN, Okorie SU. Quality evaluation of malted and fermented maize-groundnut infant weaning foods. Journal of Food Science and Technology. 2002;39(6):690-693.
10. Enwere NJ. 1st edition. Foods of Plant origin: Processing and utilisation with recipes and technology profile. pp 56-60. Afro-orbis publications Ltd. Nsukka. for human nutrition. 1998;49:271-282.
11. Ghavidel RA. The impact of germination and dehulling on nutrients, antinutrients, in vitro iron and calcium bioavailability and in vitro starch and protein digestibility of some legume seeds. Dept of studies in food science and nutrition, Jamuna Prakash, University of Mysore, India; c2006.
12. Gupta M, Abu-Ghannam N, Gallaghar E. Barley for brewing: characteristics changes during malting, brewing and applications of its by-products. Comprehensive Reviews in Food Science and Food Safety. 2010;9:318-328.
13. Inyang CU, Zakari UM. Effect of germination and fermentation of pearl millet on proximate, chemical and sensory properties of instant “Fura”: A Nigerian cereal food. Pakistan Journal of Nutrition. 2008;7(1):9-12.
14. Jackson ML. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi; c1973.
15. Jaiswal PC. Soil, Plant and Water analysis, Kalyani publication, New Delhi; c2003. p. 279-280.
16. Khatun H, Haque MR, Hosain MM, Amin MHA. Evaluation of weaning foods formulated from germinated wheat and lentil flour from Bangladesh. Bangladesh Research Publications Journal. 2013;8(2):152-158.
17. Kirk-Uthmar, O. Food and Feed Technology. New York: Wiley-Interscience. 2007, pp 116-s120.
18. Mansour EH. Biological and chemical evaluation of chickpea seed proteins as affected by germination, extraction and ɑ-amylase treatment. Plant foods for human nutrition. 1996;49:271-282.
19. Mridula, D., Jain, R. and Singh, K.K. Effect of storage on quality of fortified Bengal gram sattu. Journal of Food Science and Technology. 2010;47:119-123.
20. Ndife J, Abdulraheem LO, Zakari UM. Evaluation of the nutritional and sensory quality of functional breads produced from whole wheat and soybean flour blends. African Journal of Food Science. 2011;5:466-472.
21. Nnam NM. Evaluation of effect of sprouting on the viscosity, proximate composition and mineral contents of Hungary rice, acha (*Digiterai exilis*) flours. Nigerian Food Journal. 2000;18:57-62.
22. Oluwole OB, Kosoko SB, Owolabi SO, Adeyoju AO, Bankole AO, Ozumba AU, *et al*. Development and production of high protein and energy density beverages from blends of maize (Z*ea mays*), sorghum (S*orghum bicolor*) and soybeans (G*lycine max*) for school aged children: effect of malting period on selected proximate parameters and sensory qualities of developed beverages. International Journal of Applied Science and Technology. 2012;2(7):285-292.
23. Rababah TM, Al-Mahasneh MA, Ereifej KI. Effects of chickpea, broadbean or isolated soy protein additions on the physicochemical and sensory properties of biscuits. Journal of Food Science. 2006;71:438-442.
24. Uwaegbute AC, Iroegbu CU, Eke O. Chemical and sensory evaluation of germinated cowpeas (*Vigna unguiculata*) and their products. Food Chemistry. 2000;68:141-146.
25. Wang YYD, Fields. Germination of corn and sorghum in the home to improve nutritive value. Journal of Food Science. 1978;43:1113-1115.